



UNIVERSITI PUTRA MALAYSIA

***TRICHODERMA* PERS. EX FR. AND ITS EFFICACY AS A BIOLOGICAL
CONTROL AGENT OF BASAL STEM ROT OF OIL PALM
(*ELAEIS GUINEENSIS* JACQ.)**

G. N. M. ILIAS

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By
G. N. M. ILIAS

**Thesis Submitted in Fulfilment of the Requirements for the
Degree of Doctor of Philosophy in the Faculty of
Science and Environmental Studies,
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January 2000



To my Parents
for their love and 'Doa' which nourishes my inspiration

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Doctor of Philosophy.

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January 2000

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Faculty : Science and Environmental Studies

This study evaluated the potential of species of *Trichoderma* as a bio-control agent against *Ganoderma boninense* Pat., the causal pathogen of 'basal stem rot' of oil palms. Out of 102 *Trichoderma* colony-forming units (CFU) isolated from oil palm rhizospheres, 39 were *T. harzianum* Rifai, 38 were *T. aureoviride* Rifai, 19 were *T. longibrachiatum* Rifai and 5 were *T. virens* (Miller, Giddens and A. A. Foster) von Arx. Isolate T43 showed overlapping characteristics between *T. hamatum* and *T. harzianum* and was termed 'indeterminable' taxonomically. All isolates were screened for their antagonistic properties against *G. boninense* (isolate PP28) by dual culture studies, from which isolates T32 (*T. harzianum*) and T128 (*T. virens*) were selected as the two most effective antagonists. *In vitro* non-mycelial studies by normal and bilayer poison agar techniques and of culture filtrates, showed that secondary metabolites produced by the two selected isolates were able to suppress growth of *Ganoderma* on agar as well.

In greenhouse trials using *Trichoderma*-incorporated mulch, all 5 control plants were killed by *Ganoderma* at 24 weeks after infection, whereas the survival rates were 60% and 20% when treated with T32 and T128 respectively. These were 80% for T32 and 40% for T128 using clonal plants for the same experiment. Two out of 4 modes showed very good disease control when *Trichoderma* was used as conidial suspension. As a root coating supplemented by *Trichoderma*-incorporated mulch at the start of experiment, the survival rate was 90% when treated with T32 and 70% with T128. When applied directly (1 L/plant once every fortnight for 12 weeks), a survival rate of 90% using T32 and 80% using T128 were obtained. In the use of its secondary metabolites, 2 out of 3 modes of application gave very good results. The first was by direct application of secondary metabolites (300 ml/plant at fortnightly intervals for 6 times), which resulted in a survival rate of 70% when treated with T32 and 60% when treated with T128. The second was its application as root coating followed by a single boost of 300 ml of the metabolite given only once at the start of the experiment, which resulted in a survival rate of 70% using T32 and 40% using T128.

Trichoderma treatments were found to be effective when applied at the start of experiment but were no longer effective in delayed treatments of 6 to 8 weeks after infection. T32 (*T. harzianum*) showed better efficacy than T128 (*T. virens*) for all experiments. *Trichoderma* treatments which gave good survival rates and which could be commercially exploited were its use in the form of conidial suspension, whether applied indirectly as a root coating or poured directly on to soils of infected plants.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah.

**TRICHODERMA PERS. EX FR. DAN KEBERKESANANNYA SEBAGAI
AGEN KAWALAN BIOLOGI KEPADA PENYAKIT REPUT PANGKAL
BATANG POKOK KELAPA SAWIT (*ELAEIS GUINEENSIS* JACQ.)**

Oleh

G. N. M. ILIAS

Januari 2000

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Kajian ini telah menilai keupayaan beberapa spesies *Trichoderma* sebagai agen bio-kawalan untuk *Ganoderma boninense* Pat., penyebab penyakit 'reput pangkal batang' pada pokok kelapa sawit. Daripada 102 pencilan unit pembentukan-koloni (CFU) *Trichoderma* yang didapati daripada habitat mikrob kawasan akar atau rizosfera kelapa sawit, 39 adalah *T. harzianum* Rifai, 38 adalah *T. aureoviride* Rifai, 19 adalah *T. longibrachiatum* Rifai dan 5 adalah *T. virens* (Miller, Giddens and A. A. Foster) von Arx. Pencilan T43 menunjukkan sifat-sifat pertindihan *T. hamatum* dan *T. harzianum* dan ia dianggap sebagai pencilan 'yang tidak dapat diputuskan alafnya' dari segi taksonomi. Kesemua pencilan telah di skrin ciri antagonisnya terhadap *G. boninense* (pencilan PP28) melalui kajian dwikultur. Pencilan T32 (*T. harzianum*) dan T128 (*T. virens*) telah dipilih sebagai 2 pencilan antagonis yang paling berkesan. Kajian tanpa miselium *in vitro* melalui kaedah agar beracun biasa dan dwilapis dan juga melalui kajian turasan kultur telah menunjukkan bahawa hasil daripada metabolit

sekunder oleh kedua-dua pencilan yang dipilih dapat merencat pertumbuhan miselium *Ganoderma* di atas agar.

Dalam kajian rumah hijau pula, melalui rawatan kultur *Trichoderma* dalam sungkupan serabut kelapa sawit, kesemua 5 pokok kawalan mati terkena jangkitan *Ganoderma* pada minggu ke 24, manakala anak benih rawatan T32 dan T128 masih hidup pada kadar kemandirian 60% dan 20%. Kadar kemandirian pokok klon adalah 80% bagi rawatan dengan T32 dan 40% bagi rawatan dengan T128. Dua daripada 4 cara menggunakan ampaian konidium *Trichoderma* telah memberikan kawalan penyakit yang baik. Dalam penggunaan ampaian konidium sebagai celupan akar yang dilengkapi dengan *Trichoderma* dalam serabut kelapa sawit, kadar kemandirian ialah 90% melalui rawatan T32 dan 70% dengan T128. Apabila ampaian konidium disiram secara terus ke tanah (1 L/pokok setiap 2 minggu selama 12 minggu), sejumlah 90% anak pokok rawatan T32 masih hidup, manakala 80% untuk rawatan T128 hidup pada akhir ujikaji. Dalam penggunaan metabolit sekunder, 2 daripada 3 cara rawatan telah memberikan keputusan yang baik. Rawatan pertama ialah secara siraman terus ke tanah (300 ml/pokok sebanyak 6 kali setiap dua minggu), di mana kadar kemandirian ialah 70% dengan menggunakan T32 dan 60% dengan menggunakan T128. Cara kedua ialah rawatan tidak-terus melalui celupan akar diikuti dengan satu dos tambahan 300 ml metabolit pada permulaan ujikaji, di mana kadar kemandirian didapati ialah 70% dengan rawatan T32 dan 40% dengan rawatan T128.

Rawatan *Trichoderma* adalah berkesan apabila dilakukan pada permulaan ujikaji tetapi tidak berkesan untuk rawatan yang ditangguhkan 6 hingga 8 minggu selepas jangkitan. Dalam kesemua ujikaji, T32 (*T. harzianum*) telah menunjukkan keberkesanan yang lebih baik daripada T128 (*T. virens*). Rawatan *Trichoderma* yang menunjukkan keberkesanan yang baik serta boleh dieksploitasikan untuk kegunaan komersil adalah penggunaannya dalam bentuk ampaian konidium, samada melalui celupan akar atau aplikasi secara siraman langsung pada pokok terjangkit.

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I certify that an Examination Committee met on 5th January 2000 to conduct the final examination of G. N. M. Ilias on his Doctor of Philosophy thesis entitled "*Trichoderma* Pers. ex Fr. and its efficacy as a biological control agent of basal stem rot of oil palm (*Elaeis guineensis* Jacq.)" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. The Committee Members for the candidate are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that this thesis has not been previously or concurrently submitted for any other degree at UPM or any other institutions.

Signed



(G. N. M. ILIAS)

Date 3 March 200

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